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Weed control practices in wheat (*Triticum aestivum* L.) under arid conditions of Southern Punjab, Pakistan

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Abstract

Wheat as a major staple food faces substantial yield losses attributable to weeds. In arid areas the situation is worse as a consequence of limited nutrient accessibility by the crop. There is a dire need to establish cultural weed control strategies posing less environmental threat, as caused by chemical control methods. An experiment was designed to appraise the cultural weed control practices along with chemical control. Four treatments of different line orientation and seed rate i.e., 15 cm apart single row spacing,15 cm apart cross row spacing, 30 cm apart single row spacing with increased seed rate @25kg/ha, 30 cm apart cross row with increased rate @25kg/ha laid out in RCBD design, were evaluated together with one chemical and one weedy check treatment. Yield and yield parameters collected revealed that 15 cm apart cross row spacing gave the highest yield compared to all other treatments. The results were statistically similar to the chemically treated plots. Highest wheat yield was obtained in 15 cm apart cross row spacing (3887 kg/ha). The results confirmed that application of efficient plotting orientation can be a promising strategy in mitigating the environmental pollution caused by use of weedicides.

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Introduction

Wheat (*Triticum aestivum*) being the stable food of Pakistan, has a significant position in terms of food security and uplift of economy. Pakistan was ranked as 8th largest wheat producing country in2009, however the yield declined in the current years. The decline is more under irrigated production system as compared to rain fed. It is ranked below other countries, predominantly Canada, United States of America and Ukraine (Prikhodko and Zrilyi, 2013). In Pakistan wheat Contributes about 13% to the value added in agriculture and 2.8 % to the GDP.

During the past five years an increase in the wheat cultivated area and yield production has been observed in Pakistan. In 2016-2017 the cultivated area was 6660 thousand hectares which gave a yield of 3073 kg/hectare. Considering this it is clear that there is a dire need to enhance the wheat production in order to meet the need of increasing populations and also to compete with other countries. The reasons for reduction in yield are fewer rainfalls, less availability of canal water and unfavorable environmental conditions during the month of March (Agripunjab, 2018).

In southern Punjab especially the areas prone to arid conditions, wheat is facing decline in yield production owing to the haphazard meteorological events. In such situation obtaining satisfactory wheat production under limited resources is necessary. Along various others factors, weeds are the major yield decreasing contributors in wheat.

They are described as noxious pests that affects wheat qualitatively and quantitatively in a negative way (Khaliq *et al.*, 2011).Thus making it the least priority product for eating and marketing purpose (Asad *et al.*, 2017). In addition, weeds increase the expenses of threshing, cleaning and harvesting (Abbas *et al.*, 2009) contributing to cost extravasion (Asad *et al.*, 2017).

The phenomenon behind yield reduction is through the competition for light, water and nutrients. The pests can reduce the yields up to 10-40% on an average. There are many examples throughout the history in which pest attacks had cause destruction to crops (Fried *et al.*, 2017).

With the passage of time, the advancement in variety development has paved ways for enhancing crop production in drought prone areas. The research institutes in southern Punjab are working vigorously in developing varieties adaptable to the changing climate scenarios.

Previous researches on *Triticum aestivum* have shown a slow growth rate of crop variety replacement by farmers in promoting new varieties of wheat in Pakistan (Iqbal *et al.*, 2002).

Furthermore, there is a wide range of chemicals for weed control, which decrease the labour constraints for weeding during the growth season (Farooq *et al.*, 2011; Rehman *et al.*, 2015).However for controlling weeds various factors like the cultivar type, planting density, orientation and row spacing can play a significant role by reducing the competitiveness between wheat and weeds (Van der Meulen and Chauhan, 2017). The objectives of this study is to determine the best combination of weed control methods in wheat crop. Chemical weed control is extensively studied but no research has been carried out so far for evaluating a newly developed wheat variety i.e., Gold -16 for its ability to withstand weeds influence under various planting density and row orientation weeds control strategies.

Material and methods

Site description

A two year (2016-2018) experiment was conducted at the research area of Regional Agricultural Research Institute Bahawalpur, Pakistan. The research area is situated amid of the city and a variety of crops are grown on which different researches are carried out. A meteorological observatory is present at the research farm from which the mean temperature, humidity and rainfall patterns are observed on the daily basis.

Treatments and layout

The treatments included different plant densities and sowing patterns in order to assess the yield and yield parameters. Apart from this, a chemical treated plot and a control (weedy check) was also maintained.

The treatments were,T1 chemical, T2control (weedy check) , T3 15 cm apart single row spacing, T4 15 cm apart cross row spacing, T5 30 cm apart single row spacing with increased seed rate(25 kg/ha) , T6 30 cm apart cross row spacing with increased seed rate (25kg/ha). The experiment was laid out in RCBD design with three replicates.

A seed rate of 125 kg/ha was used as the normal seed rate because of the climatic fluctuations in the area. A single plot has the dimensions of 3m*8m.A newly developed wheat variety of regional agricultural research institute was the test crop. The characteristics of the variety are given in the Table 1.

The weed density was also recorded at the initial crop stages. The yield and yield parameters were determined. The variables measured and analyzed were plant height, plant population, spike length, 1000 grain weight and final grain yield.

Data analysis

Data were statistically analyzed by using software statistics 8.1, according to the procedure described by Steel (1997) for randomized complete block design and means were separated by least significant differences test ($P < 0.05$) upon significant F- test.

Results and discussion

An overall significant result was found in all treatments when means were compared with each other. The highest yields were obtained in case of both chemical as well as a treatment of cultural control.

The maximum yield was obtained in case of chemical control giving a value of 3966 kg/ha while the cultural treatment (15 cm apart cross row spacing) was statistically at par to T1 giving a value of 3886 kg/ha. T3 (30 cm apart single row spacing) also gave good results having a value of 3730 kg/ha. However theses values were significantly different and lower as compared to other treatments. T2, T5 and T6 gave yield of 3334, 3210 and 3336 respectively.

These three values were statistically at par to each other (Table 2).

Table 1. Characteristics of the test wheat variety.

Characters	Values
Days to heading	85-90
Days to maturity	134-140
Plant height (cm)	87–99
Lodging Resistant	Tolerant
Tillers per meter row	134
1000 Kernel weight (gm)	38-43
Protein (% age)	13
Disease Reaction	Resistant/Tolerant
Number of grains/spike	45-55
Grain Size	Medium
Maturity Status	Medium
Growth habit	Semi Erect
Yield potential (kg/ha)	7900
Average Yield (kg/ha)	4200

Thousand grain weight also differ in case of each treatment. The maximum weight (49.6 g) was obtained under 15 cm apart cross row spacing while the minimum was obtained in control weedy check (43.2 g) the other treatments results is depicted in Table 3. In addition the other yield determining parameters also varied among the treatments and the detail is represented in Table 3.

Discussion

The results from our experiment suggest that row spacing and sowing orientation plays a significant role in reducing weed crop competition. Weedicides are extensively used in agricultural systems but their negative environmental effects widely disturbing our ecosystems. In our case the 15 cm apart cross row was significantly good ($p<0.05$) as compared to other treatments. This might be due to the lesser area available to the emerged weeds to compete with the main crop. Our results are in accordance with Fahad *et al* (2015) who also stated that under narrow row spacing (11-cm) less growth of weed species was observed when compared to wider spaced rows (15 and 23-cm). Hewitt (2015) revealed that under narrow row spacing there is low weed pressure and under moderate to high weed pressure, narrow row spacing out yielded the wider ones.

The reasons behind this yield increment or reduction lies utmost on the crop and weed competition. It determines the crop ability to compete with the weeds. A successful competition will promise higher grain yield which ultimately narrow down the gap between production and consumption (ElSayedHasan Mohamed Fayed *et al.*, 2018).

Table 2. Effect of various weed control practices on wheat crop.

Treatments	Thousand grain weight	Yield kg/ha
Chemical control	48	3966.8 A
Control weedy check	43.2	3334.3 B
15 cm apart single row spacing	47.2	3730.8 AB
15 cm apart cross row spacing	49.6	3886.6 A
30 cm apart single row spacing with increased seed rate 25 kg/ha	50	3210.6 B
30 cm apart cross row spacing with increase seed rate 49	46	3336.6 B
		LSD @ 0.05= 523

Seed rate also influences the weed suppression. In our case the treatment with normal seed rates were higher even with the treatments in which we used increased seed rate. These results neglect the statement given by Bajwa *et al.*, (2017) who claimed that increased seed rate in narrow or altered rows spacing also improve crop competition.

In another study it was demonstrated that if we narrow down the row spacing to half, then the weed biomass decrease up to 39 to 68 percent, .the variation in decrease depends on the weed species (Mhlanga *et al.*, 2016).

A research carried out explained that highest yield was obtained in case of 30 cm apart cross row drill sowing (Iqtidar *et al.*, 2003). They explained that uniform seed distribution, less lodging and uniform utilization of the resources is the basic phenomenon behind the increase. In our study the maximum yield obtained in 15 cm apart cross row may be due to the same trend.

In such case our study is also in accordance Perihar and Singh (1995) and Arif *et al.*, 1997). Parihar and Singh in their study revealed that cross sowing increased yield by 4.3 % when compared to the line sowing. In another study the increase in grain yield was attributed due the reduction in weed biomass. Previous studies are also in accordance claiming that less weed completion occurs in cross drill sowing and when row distance is decrease as in our case (15 cm apart cross row spacing.) But contrary to this Qazi and Shamsudin (2002) claimed that lowest weed control was obtained clos row along with herbicides.

This is also inverse in our study because we achieved highest yields in case of chemical as well as close row spacing. From the previous studies it is confirmed that planting method can have significant effect on control of weeds because it influences water, nitrogen and phosphorus uptake saves energy and affect soil compaction (Trodson *et al.* 1989). PAR absorptions is also influence by planting methods (Lal *et al.* 1991).

Table 3. Effect of various weed control practices in wheat.

Treatment	Spike length	Plant height	No. of tillers/m²
Chemical control	14.5 A	102.5 A	286 B
Control	16 A	101 A	287 B
15 cm apart with single row spacing	15 A	102.5 A	298 AB
15 cm apart cross row spacing	14 A	103 A	326 A
30 cm apart single row with increased seed rate	14.5 A	101.5 A	225.5 C
30 cm apart cross row with increase seed rate	14.5A	104A	297.5 AB

Weed densities are higher in conventional methods as compared to cross planting affecting significant on final grain yield (Khan *et al.*, 2007), in our results chemical treated plot was statistically similar to the 15 cm apart croos row spacing. Hence we concluded that pesticide use can be narrowed down while shifting toward cultural control practices.

The same is true in other researches also. For example Bajwa *et al* (2017) said that with the enhancement in pesticide pollution, weed crop competition is an effective alternative for controlling weeds.it is also sustainable weed management strategy. Moreover, extensive herbicide induces resistance in crop after certain period of time. Cultural control can also reduce resilience on herbicides (Bajwa *et al.*, 2017).

Conclusion

Conclusively, it is evident that by simply altering the row directions and orientations we can control the yield losses caused by weeds significantly. As in this study cross row spacing has capability of increasing grain yield also, chemicals can be avoided on a larger scale. It may be a basic strategy for minimizing the chemical usage thus promoting the enhancing the environmental health. The most important benefit will be the reduction of expenses for the farmers who cannot afford to purchase chemicals. It is a society healthy option for sustaining agricultural production.

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